Aeolagrion philipi sp. nov. from Bolivia, and a review of the genus *Aeolagrion* (Odonata: Coenagrionidae)

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Abstract

Aeolagrion philipi sp. nov. is described and illustrated (holotype ♂: Bolivia, Santa Cruz department, Ñuflo de Chávez province, pooled tributary of Río San Julián, 5 km SE of San Ramón, 14 xi 1998, leg. KJT, in FSCA). The new species is closely related to *A. inca* but is distinct in shape of hind margin of prothorax, genital ligula morphology, shape of male cerci, and color pattern of female S8 (dark brown). The female of *A. axine* is described and a key to the species of the genus is provided.

Resumen

Aeolagrion philipi sp. nov. es descripta e ilustrada (holotipo ♂: Bolivia, Departamento de Santa Cruz, Provincia Ñuflo de Chávez, tributario del Río San Julián, 5 km SE de San Ramón, 14 xi 1998, leg. KJT, en FSCA). La nueva especie está estrechamente relacionada con *A. inca*, pero se diferencia de ésta por la forma del margen posterior del protórax, la morfología de la lígula genital, la forma de los cercos masculinos, y el patrón de coloración de S8 de las hembras (marrón oscuro). Se describe la hembra de *A. axine* y se proporciona una clave para las especies del género.

Introduction

Aeolagrion is a South American coenagrionid genus which has presented taxonomic problems ever since Williamson (1917) introduced it to receive several species that did not appear to belong in the genus *Leptagrion*. Williamson designated *Agrion dorsale* Burmeister, 1839 as type species of this new genus and included two other taxa, a new species *Aeolagrion demararum* and *Leptagrion flammeum* Selys, 1876, the latter with hesitation. The former species was subsequently placed in *Telebasis* (Dunkle 1991; see also Bick & Bick 1995); Garrison (2009) amended the species name to *demarara*. *Aeolagrion flammeum* was placed in a new genus, *Phoenicagrion*, by

von Ellenrieder (2008). Other species that had tentatively been placed in *Aeolagrion* and which have predominantly red coloration and cylindrical male cerci (*A. chimantai* De Marmels, 1988; *A. fulvum* Needham, 1933; *A. neblinae* De Marmels, 1989) were recently placed in the genus *Tepuibasis* (De Marmels 2007).

Two other species originally described in *Leptagrion* have also been placed in *Aeolagrion*. Rácenis (1959) moved *L. inca* Selys, 1876 to *Aeolagrion*, stating in a footnote that this transfer was based on wing venation; this was undoubtedly based on Williamson's 1917 key (p. 242) as he gave no distinguishing venational details. *L. foliaceum* Sjöstedt, 1918, described from Brazil, was listed by Davies & Tobin (1984) under *Aeolagrion*. Dunkle (1991) indicated that *A. foliaceum* might be synonymous with *A. inca* based on similarity of their descriptions, and subsequently Lencioni (2006) synonymized *A. foliaceum* with *A. inca*. The most recently described species of *Aeolagrion* is *A. axine* Dunkle, 1991 from Ecuador. In order to identify specimens from Bolivia, which appeared to be congeneric with other *Aeolagrion* based on coloration and expanded male cerci, I examined critically the various taxa remaining in *Aeolagrion*, *A. axine*, *A. dorsale*, and *A. inca*. The genital ligula shown by Leonard (1977: 159, figs A1, A2) as *Aeolagrion* sp. belongs to *Acanthagrion fluviatile* (De Marmels 1984).

The purposes of this paper are to describe the species from Bolivia as new, describe the previously unknown female of *A. axine*, diagnose the genus *Aeolagrion*, and provide a key to all species of *Aeolagrion*.

Material and methods

Illustrations were made with aid of camera lucida on a stereomicroscope and are not to scale. All measurements were made under a binocular microscope with an ocular micrometer. Length of the sharp process on the genital ligula of the new species and *A. inca* was measured along the entire curve of the process from base to apex. Pterostigma length was measured along the costa and includes the widths of the enclosing proximal and apical crossveins. Wing nomenclature follows Riek & Kukalová-Peck (1984).

Abbreviations:

AL — abdomen length
BM — B. Mauffray
Dept — Department
FSCA — Florida State Collection of Arthropods, Gainesville, FL, USA
HfL — hind femur length
HwL — hind wing length
IRSN — Institut Royal des Sciences Naturelles de Belgique, Bruxelles, Belgium
JJD — J.J. Daigle
KJT — K.J. Tennessen, Wautoma, WI, USA
MCZ — Museum of Comparative Zoology, Harvard University, MA, USA
Prov — Province
PtL — pterostigma length (hind wing)
UMMZ — University of Michigan Museum of Zoology, Ann Arbor, MI, USA
TL — total length

Aeolagrion philipi sp. nov.

Figs 1a-g, 4d, 7c

Etymology

The new species is named for Philip S. Corbet (noun in the genitive case), colleague and friend who greatly furthered the understanding and study of dragonfly behavior and ecology.

Specimens examined

Holotype ♂, Bolivia, Santa Cruz Dept, Ñuflo de Chávez Prov, pooled tributary of Río San Julián, 5 km SE of San Ramón (16°38'42.3"S, 62°30'31.6"W), 14 xi 1998, leg. KJT (FSCA). Paratypes: 50 ♂, 21 ♀, Bolivia, Santa Cruz Dept, Ñuflo de Chávez Prov: 1 ♀ in tandem with holotype (FSCA); 1 ♂, borrow pit 3.4 km W of San Ramón, highway 7, 08 xi 1998, leg. BM (FSCA); 6 ♂, 1 ♀ & 1 ♀ in tandem, pond near Río San Julián, 4 km S of San Ramón (16°38'42"S, 62°30'32"W), 14 xi 1998, leg. KJT (FSCA); 4 ♂, same but 14 xi 1998, leg. BM (FSCA); 2 ♂, 2 ♀, same but 08 xi 1999, leg. KJT (FSCA); 4 ♂, 1 ♀, same but 12 viii 2003, leg. KJT (FSCA); 1 ♂, pond 4.2 km E of San Ramón, 15 xi 1998, leg. KJT (FSCA); Guarayos Prov: 7 ♂, 8 ♀, forest near Río San Julián, Cachuela de Yotaú (16°58'30"S, 63°05'52"W), 15-16 viii 2003, leg. KJT (FSCA); 1 ♀, pool and stream 6 km NE of highway 9, road from Santa María to Yaguarú (15°40'54"S, 63°25'36"W), 25 viii 2003, leg. KJT (FSCA); 2 ♂, 1 ♀, canal 9.9 km NE of highway 9, road from Santa María to Yaguarú (15°40'24.9"S, 63°23'55.3"W), 26 viii 2003, leg. KJT (FSCA); 4 ♂, slough, Río Blanco, 1.5 km N of Urubicha (15°37'5.7"S, 63°04'36"W), 27 viii 2003, leg. KJT (FSCA); 1 ♂, 1 ♀ in tandem, small stream 2.1 km N of Urubicha (15°37'00.9"S, 63°04'15.5"W), 27 viii 2003, leg. KJT (FSCA); Ichilo Prov: 1 , pond and stream 18 km W of Buena Vista, 8 km W of San Carlos, 17 iii 1960, leg. R.B. Cumming (FSCA); 1 ♂, borrow pit 17.5 km E of Buena Vista, highway 7, 08 xi 1998, leg. BM (FSCA); 1 ♂, pond 3 km S of Buena Vista, 05 ii 2001, leg. KJT (FSCA); 2 ♂, 3 ♀, *Heliconia* pond 3.5 km S of Buena Vista, 06-10 ii 2001, leg. KJT (FSCA); 1 ♂, Lagunas Curichi, 3.5 km S of Buena Vista, 04 ii 2000, leg. JJD (JJD); Sara Prov: 9 ♂, 1 ♀, also 1 ♂, 1 ♀ in copula, pond near Río Palometillas, E of Buena Vista, 08 xi 1998, leg. KJT (FSCA); Velasco Prov: 1 ♂, Río San Martín, 70 km N of Santa Rosa de la Roca, 12 xi 1999, leg. KJT (FSCA).

Additional specimens

Total 18 ♂, 3 ♀. — Bolivia: Beni Dept, Cercado Prov: 1 ♀, 2 km N of Loma Suárez, forest (14°45'01.5"S, 64°57'20.7"W), 21 viii 2003, leg. BM (FSCA); Santa Cruz Dept, Guarayos Prov: 1 ♂, 15 km W of Yotaú, Cachuela de Yotaú (16°14'48.5"S, 63°05'52"W), 15 viii 2003, leg. BM (FSCA); 1 ♂, El Puente, 0.5 km S on highway 9, along small woodland stream, (16°30'03.8"S, 62°53'57.3"W), 28 viii 2003, leg. BM (FSCA); Ichilo Prov: 1 ♂, pond and stream, 18 km W of Buena Vista, 8 km W of San Carlos, 17 iii 1960, leg. R.B. Cumming (FSCA); Ñuflo de Chávez Prov: 14 ♂, 1 ♀, and 1 ♂, 1 ♀ in tandem; 4 km SW of San Ramón on highway 9, Río San Julián, pond on NE side of bridge (6°38'42.3"S, 62°30'31.6"W), 12 viii 2003, leg. BM (FSCA).

Male holotype

Head: Labium tan; labrum, base of mandible, gena, anteclypeus, postclypeus blue; clypeofrontal suture dark brown; frons angulate, vertical antefrons blue laterally, light brown medially, horizontal postfrons black; antenna black, top of head black except for (1) small pale spot anterior to median ocellus, (2) pale band extending from lateral ocellus to base of antennae, and (3) small pale twin spot posterior to ocelli (on postfrontal suture); postocular spots absent; rear of head blue-tan except narrow lateral black bar along edge of compound eyes extending about half way down.
Thorax: Prothoracic anterior lobe pale blue, middle lobe blue laterally, black medially edged in brown, hind lobe blue laterally, black medially with hind margin entire and very slightly concave (Fig. 1a); propleura blue. Middorsal carina of pterothorax black; middorsal stripe black with coppery reflections, 0.75 mm wide at midlength; wide black stripe completely ventral to humeral suture, slightly wider (0.32 mm at midlength) than blue antehumeral stripe, narrowed at upper end; mesinfraepisternum black on upper half, blue ventrally; rest of side of thorax blue except upper end of metapleural suture brown; venter tan, pruinose. Coxa pale blue, femur tan with black dorsal stripe, tibia tan, tarsal segments mostly tan but dark apically, claws caramel with black tips, distinct supplementary tooth; leg spines black, on hind tibia long spines slightly longer than spaces between bases of adjacent spines. Wings stalked to level of CuP. Px 10 in Fw, 8 in Hw; Pt black with very narrow pale edges next to enclosing black veins.

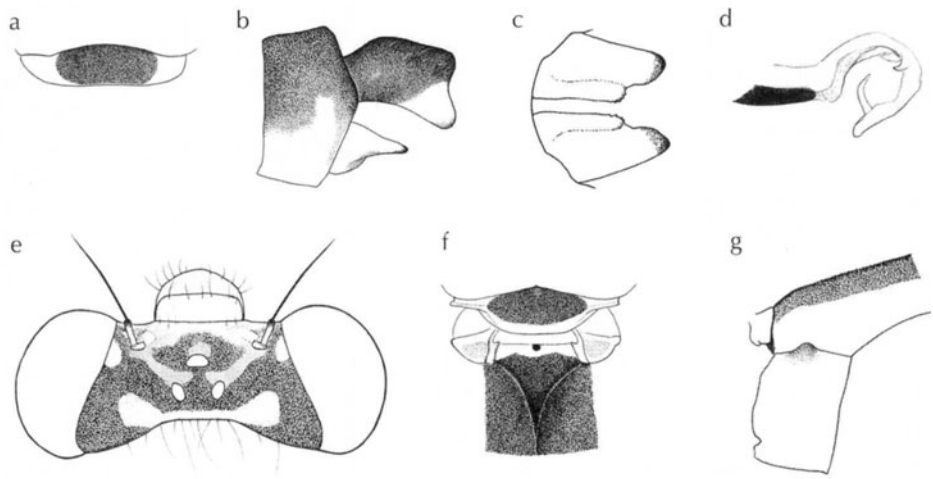

Figure 1: *Aeolagrion philipi* sp. nov., male holotype, female paratype (in tandem with holotype) — (a) male hind lobe of pronotum, dorsal view; (b) male S10 and appendages, left lateral view; (c) male paraprocts, ventral view; (d) genital ligula, left lateral view; (e) female head, dorsal view; (f) female thorax, dorsal view; (g) female mesanapleural suture, left lateral view.

Abdomen: S1-7 black middorsally, blue laterally; S8-9 entirely blue except narrow black mark apicolaterally; S10 black dorsally and dorsolaterally, blue ventrolaterally (Fig. 1b). Cercus nearly 1.5 times longer than S10 measured along dorsum, in lateral view lobate and wider apically than basally, lateral surface mostly dark brown except ventrad projecting lobe pale (Fig. 1b), dorsal edge and medial surface pale, concave, membranous, covered with long, curved pale setae. Paraproct blue, in lateral view evenly tapered to blunt tip (Fig. 1b), in ventral view tips angularly blunt and nearly parallel (Fig. 1c). Distal segment of genital ligula entire, with sharp-tipped, slightly sclerotized, sickle-shaped medial process and lateral proximal folds; internal and terminal folds vestigial (Fig. 1d).
Measurements: TL 30.0; AL 24.3; HwL 15.2; HfL 2.6; PtL 0.62; cercus 0.58.

Female paratype

In tandem with holotype.
Head: Edge of labrum tan, darker medially, postclypeus blue, top of head dark brown with extensive pale brown markings (Fig. 1e); antennomeres 1 and 2 pale; rear of head pale tan with lateral narrow brown bar near compound eye similar in shape to black bar of male.
Thorax: Color pattern of prothorax similar to male except middle lobe mostly tan to light brown dorsally with small dark brown mark medially; posterior margin of hind lobe in dorsal view entire but more constricted than in male, with narrow low lateral ridges (Fig. 1f). Mesostigmal laminae green-tan, separated by about twice the width of a single lamina, each triangular with slight medial depression, outer corner slightly raised, length about 0.75 of width (Fig. 1f). Humeral stripe very faint brown ventral to humeral suture, rest of side of pterothorax tan; venter pale tan with slight pruinescence posterior to hind coxae. Mesanapleural suture convex at midlength, black circular mark under convexity on tan mesinfraepisternum (Fig. 1g). Pt brown.
Abdomen: S1-10 black-brown dorsally, S2 with narrow, fine middorsal longitudinal pale line; S8 without vulvar spine. Cercus shape basically conical except in lateral view dorsal margin convex, ventral margin straight. Ovipositor tan, apex of gonapophyses extending slightly beyond ventral margin of S10 (to midlength of anal lobes), pale setae along ventral margin of outer valve increasing in density and length apically (more clustered at apex and from approximately 0.05 to 0.07 mm long); stylus curved downward slightly, 0.24 mm long.
Measurements: TL 29.0; AL 23.5; HwL 15.5; PtL 0.61; cercus 0.30.

Variation among paratypes

The color pattern on top of the head in several males is similar to that of the paratype female described, including pale postocular spots; in one female the top of the head is nearly completely black, similar to that of the holotype. In some females the labrum and anterior aspects of the head are light tan-blue. Several males have circular black spots on the rear of the head along the foramen, and one has the dorsal half black. The dorsum of the prothoracic middle lobe is entirely dark brown in several females. The greatest variation in color pattern is in the dark posthumeral stripe which ranges from slightly wider than in the holotype to half as wide or nearly absent, with only a faint brown stripe present; in several females the humeral stripe is

darker brown and more discernible, although not sharply defined, than in the described female. In several males S2, and more rarely S3 also, has a narrow, medial, longitudinal pale brown or blue stripe; four males have a small, circular, basomedial pale blue spot on S10, and one has a smaller dorsolateral blue spot at midlength. In some females the sides of S2+3 are blue and in a few S9 has an elongate dorsolateral apical pale brown spot. The ventrally directed lobe of the male cercus in some males is slightly more elongate and sometimes darker, and the tips of the paraprocts are convergent.

Measurements: TL: ♂ 27.7-30.8, ♀ 26.5-30.8; AL: ♂ 22.5-25.0, ♀ 21.0-24.7; HwL: ♂ 14.3-16.0, ♀ 15.0-16.8; PtL: ♂ 0.56-0.73, ♀ 0.56-0.73; cercus: ♂ 0.54-0.61, ♀ 0.25-0.31. Px in Fw ♂ 9-12, ♀ 10-11, in Hw ♂ 8-9, ♀ 8-9.

Aeolagrion axine Dunkle, 1991

Figs 2, 3a, 4a

Aeolagrion axine Dunkle, 1991: 240 (♂ holotype, Ecuador; FSCA).

Specimens examined

Ecuador, Napo Prov: 1 ♂, 1 ♀ in tandem, pool near Río Napo, 3.2 km E of Puerto Napo, along road to Jatún Sacha, 23 vi 1996, leg. KJT (FSCA); 2 ♂, 1 ♀, pool near Río Sinde, 5.3 km E of Puerto Napo, along road to Jatún Sacha, 22 vi 1996, leg. JJD (JJD).

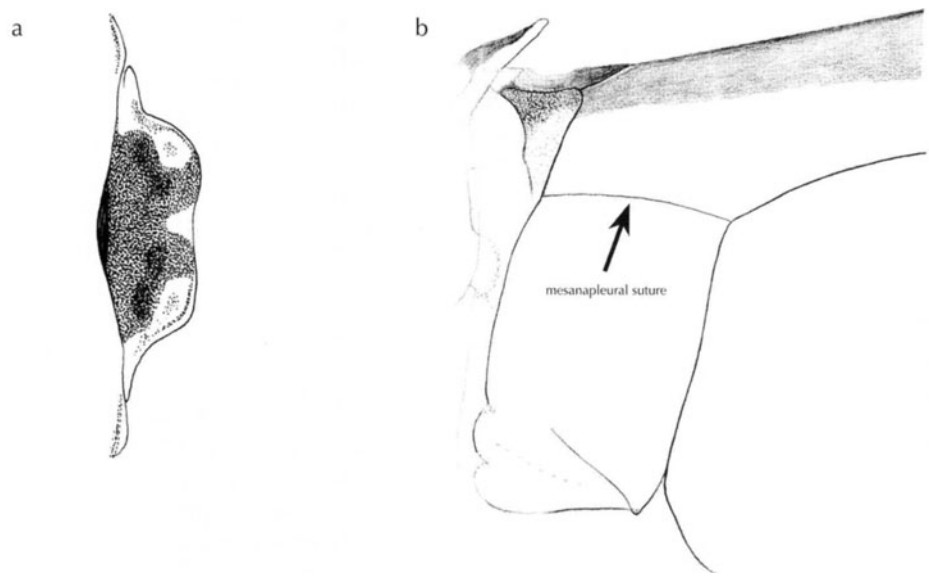

Figure 2: *Aeolagrion axine* female thorax — (a) hind lobe of pronotum, dorsal view; (b) mesanapleural suture, lateral view.

Description of the female

Head: Labium tan, gena green, base of mandible tan-green, labrum and anteclypeus dark gray-blue, postclypeus green-blue, antefrons mostly reddish brown except lower lateral corner blue-green; top of head black, without pale postocular spots or pale occipital bar; pale reddish brown streaks from lateral ocelli to red-brown bases of antennae; antennomeres 1 and 2 pale brown, rest of antenna dark brown; rear of head yellow tan.
Thorax: Anterior lobe of prothorax black except blue across midlength, middle lobe blue laterally, dorsum reddish brown with small dark brown marks; hind lobe mostly black, lateral corners blue, in dorsal view developed posteriorly into a quadrate lobe with posterior margin slightly concave (Fig. 2a). Mesostigmal laminae triangular, separated by nearly twice the width of a single lamina, each lamina mostly pale although anterior margin and inner frame may be black, with slight medial depression, length about half of its width. Middorsal stripe black, 1.0 mm wide at midlength, posthumeral stripe light reddish brown, continued forward onto mesinfraepisternum occupying upper ⅔, lower ⅓ blue to tan, mesepimeron blue, wide reddish brown stripe directly below humeral suture, metepimeron tan blue; thoracic venter pale tan. Mesanapleural suture gently curved as in typical Coenagrionidae (Fig. 2b), not markedly convex at mid-length as in other species of *Aeolagrion*. Femur with dark dorsal stripe; femur, tibia and tarsal segments dark apically, claws caramel with black tip and supplementary tooth; long spines black, longer than intervening space between adjacent spines on middle and hind tibiae. Wings slightly flavescent, Pt yellow brown.
Abdomen: S1 pale basally, dark brown on posterior ⅔ of dorsum, sides blue; dorsum of S2-10 black, sides of S2-5 light blue to blue yellow narrowly curving upward basally to midline, sides of S6-10 tan brown; S8 without vulvar spine. Cercus shape cylindrical, tip rounded. Ovipositor tan, apex of gonapophyses extending to posterior ventral margin of S10, setae along venter and at apex of valves, styli curved downward slightly, 0.23 mm long.
Measurements: TL 32.0-33.0; AL 25.7-26.5; HwL 18.6-18.8; PtL 0.92-1.00; cercus 0.31-0.33. Px in Fw 13-14, in Hw 11-12.

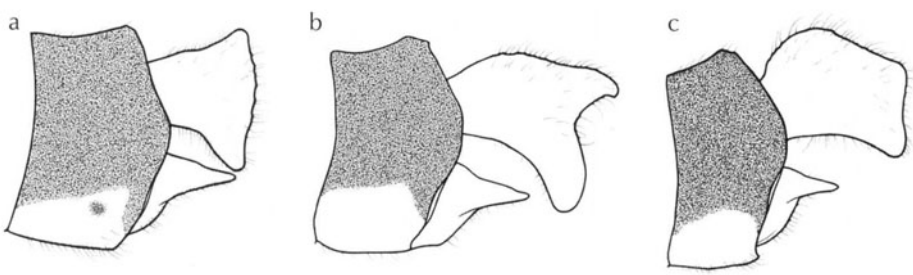

Figure 3: S10 and anal appendages of three *Aeolagrion* species — (a) *A. axine*; (b) *A. dorsale*; (c) *A. inca*, color pattern of cercus and some setae omitted.

Aeolagrion dorsale (Burmeister, 1839)

Figs 3b, 4b, 5a, 6a, 7a

Agrion dorsale Burmeister, 1839: 819 (♂, ♀, Brazil; MCZ).
Hylaeagrion argenteolineatum Förster, 1906: 15 (description). — Garrison et al. (2003: 26-27, listed in UMMZ type catalog as synonym of *A. dorsale*); synonym.
Aeolagrion dorsale (Burmeister). — Williamson (1917: 248; designation as type of the genus *Aeolagrion*, description, illustrations; Surinam, Trinidad); — Dunkle (1991: 242, key; Brazil, Ecuador, Peru, Surinam, Trinidad, Venezuela); — Lencioni (2006: 77, illustrations; Brazil, Bolivia, Ecuador, Peru, Surinam, Trinidad & Tobago, Venezuela); — von Ellenrieder & Garrison (2007: 12, examination of specimens identified by Selys in IRSN).

Specimens examined

Bolivia, Beni Dept, Cercado Prov: 7 ♂, 4 ♀, forest N of Loma Suárez, 12 km NW of Trinidad (14°45'1.5"S, 64°57'20.7"W), 21-22 viii 2003, leg. KJT (FSCA); Cochabamba Dept, Prov. Tiraque: 2 ♂, pond 7.8 km N of main highway, E of Shinahota (16°56'03.8"S, 65°10'57"W), 08 xi 2001, leg. KJT (FSCA); Santa Cruz Dept, Guarayos Prov: 3 ♀, forest near Río San Julián, Cachuela de Yotaú (16°14'058.5"S, 63°05'52"W), 15 viii 2003, leg. KJT (FSCA); 1 ♂, forest along highway 9, 17 km NW of Ascención de Guarayos (15°52'19.7"S, 63°20'03.1"W), 25 viii 2003, leg. KJT (FSCA); Ichilo Prov: 1 ♂, Buena Vista, leg. J. Steinbach (FSCA); 4 ♂, 1 ♀, Lagunas Curichi, 3.5 km S of Buena Vista, 04 ii 2000, leg. JJD (JJD, KJT); 2 ♂, Quebrada Curichi, 4 km S of Buena Vista, 07 ii 2001, leg. KJT (FSCA); Ñuflo de Chávez Prov: 1 ♂, Río San Julián, 4 km S of San Ramón (16°38'42.3"S, 62°30'31.6"W), 12 viii 2003, KJT (FSCA). Ecuador, Sucumbíos Prov: 1 ♂, swamp 17 km S of Lago Agrio [Nueva Loja], 19 viii 1980, leg. SWD (KJT); 7 ♂, ditch pool, Pompeya, 0.5 km N of Río Napo ferry, 19 vii 1996, leg. KJT (KJT). Peru, Loreto Dept: 2 ♂, Explorama Lodge, 80 km NE of Iquitos, near Amazonas & Yanamono Rivers, 31 viii 1989, leg. SWD (KJT); 1 ♀, same but leg. G.B. Edwards (FSCA). Brazil, Pará State: 1 ♀, Benevides, x 1918, leg. S.M. Klages (FSCA). Surinam, Paramaribo State: 1 ♂, 1 ♀, 23 ii 1912, leg. E.B. Williamson (FSCA); 1 ♀, Paramaribo, Botanical Gardens, 27 x 1938, leg. D.C. Geijskes (FSCA); 2 ♂, 1 ♀, same but 12 i 1939, leg. D.C. Geijskes (FSCA); Surinam, no locality, 2 ♂ labeled as *Hylaeagrion argenteolineatum*, one labeled "type ♂", assumed in Förster's handwriting; the genital ligula is the same as that of *A. dorsale* (UMMZ). Trinidad, Nariva County: 1 ♀, Nariva Swamp, 4 ix 1964, leg. C.T. Collins (FSCA).

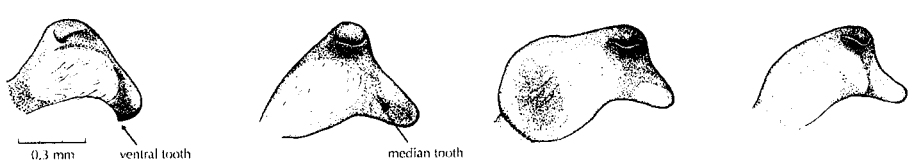

Figure 4: Male cercus of four *Aeolagrion* species, from slightly posterior, medio-dorsal view — (a) *A. axine*; (b) *A. dorsale*; (c) *A. inca*; (d) *A. philipi*.

Measurements: TL: ♂ 32.0-37.5, ♀ 30.9-35.4; HwL: ♂ 16.3-18.8, ♀ 16.9-18.1.
Notes: The mesanapleural suture in females is variable, ranging from distinctly convex at mid-length with a tubercle (Fig. 7a) to slightly convex without a tubercle. The genital ligula resembles that of *A. axine*.

Aeolagrion inca (Selys, 1876)

Figs 3c, 4c, 5b, 6b, 7b

Leptagrion inca Selys, 1876: 982 (♂, ♀, Peru, Yurimaguas, in IRSN); — Williamson (1917: 247; comparison with *L. demararum*).
Leptagrion foliaceum Sjöstedt, 1918: 13 (2 ♂, 3 ♀ Brazil, Rio Autaz [E of Manaus], Aug-Oct 1914, in Museum Stockholm); — Dunkle (1991: 242; questioned distinctness from *A. inca*); synonym.
Aeolagrion inca (Selys). — Rácenis (1959: 474; transferred to *Aeolagrion*; Peru, Yurimaguas); — Lencioni (2006: 79; synonymy of *A. foliaceum*; illustrations; Brazil, Bolivia, Ecuador, Peru).

Specimens examined

Bolivia, Santa Cruz Dept, Guarayos Prov: 1 ♀, forest near Río San Julián, Cachuela de Yotaú (16°14'58.5"S, 63°05'52"W), 17 viii 2003, leg. KJT (FSCA). Peru, Loreto Dept: 1 ♂, 3 ♀, Muenacaño, Río Amazonas, near Iquitos, viii 1939, leg. J. Schunke (FSCA); 3 ♂, 2 ♀, Amazon River, 80 km NE Iquitos, mouth of Yanamono River, 15-31 viii 1989, leg. SWD (FSCA); 1 ♀, 80 km NE Iquitos, 17 vii 1989, leg. T.C. Emmel (FSCA).

The apical abdominal segments and anal appendages of the lone *L. inca* male available to Selys were missing, but its genital ligula (syntype illustrated by N. von Ellenrieder) matches that of Sjöstedt's males of *L. foliaceum* in the Swedish Natural History Museum in Stockholm (G. Sahlén pers. comm.). The genital ligula of specimens from Peru (Loreto Dept., Muenacaño, 1939, in FSCA), identified as *A. inca* by both P.P. Calvert and M.J. Westfall, Jr., is identical also, as is that of specimens collected by S.W. Dunkle in Loreto Dept., Explorama Lodge, in 1989 (Fig. 5b). The figure of the male cercus (lateral view) in Sjöstedt (1918) also agrees with cerci of the Peru specimens. S8 of Sjöstedt's females was blue, as are those of Selys' females and

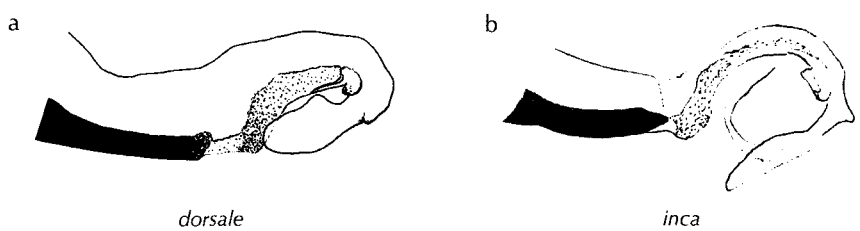

Figure 5: Genital ligula of two *Aeolagrion* species, left lateral view — (a) *A. dorsale*; (b) *A. inca*.

more recent females from Peru. These similarities leave no doubt that Lencioni (2006) was correct in considering *A. foliaceum* a synonym of *A. inca*.
Measurements: TL: ♂ 30.5-33.0, ♀ 30.0-34.0; HwL: ♂ 15.5-18.0, ♀ 15.0-18.0.

Diagnosis of the genus *Aeolagrion*

Aeolagrion most closely resembles *Telebasis*, sharing numerous character states such as angulate frons, wings stalked to level of CuP, tarsal claw with a distinct supplementary tooth, genital ligula lacking setae on shaft of basal segment (present in a few *Telebasis* species), without an accessory membranous transverse fold distal to flexure but with a minute tubercle at each laterobasal angle of flexure, female S8 sternum lacking a vulvar spine. Garrison (2009) found few characters to separate the two genera due in large part to variation among the many species of *Telebasis*. The single character he gave for distinguishing males of the two genera was the shape of the cercus, which is vertically expanded in *Aeolagrion*. I did not find any other character which would allow separation of all species of the two genera, but in addition to being large and lobate, *Aeolagrion* male cerci differ from most *Telebasis* cerci in having the medial surface shallowly concave. Color patterns of the two genera overlap; although all *Aeolagrion* species are patterned basically with blue and black, eight species of *Telebasis* are likewise blue and black instead of reddish; presence or absence of pale postocular spots is too variable to be a useful characteristic, as they may be present or absent in both genera, sometimes even varying intraspecifically. Females of *Aeolagrion* have widely separated mesostigmal laminae as in *Telebasis*, but most species of *Telebasis* (36 of 50) have a pair of strap-like processes or variably-sized medio-lateral tubercles on the dorsum of the prothorax (entirely absent in all four *Aeolagrion*). The mesanapleural suture is straight to slightly convex in female *Telebasis* (highly convex in three *Aeolagrion* species, slightly convex in *A. axine*).

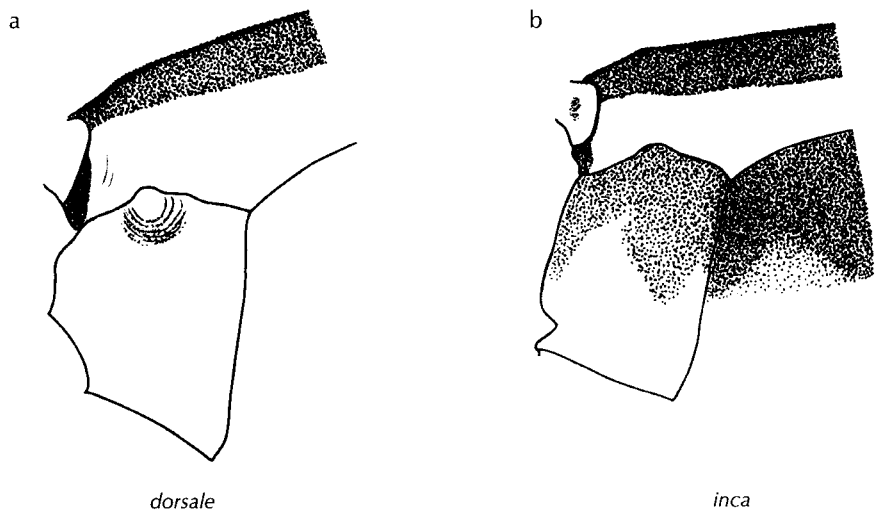

Figure 6: Female mesanapleural suture of two *Aeolagrion* species — (a) *A. dorsale*; (b) *A. inca*.

Key to males of *Aeolagrion*

1. Cercus in lateral view ax-head shaped with distal margin convex, tip of paraproct reaching tip of ventral lobe (Fig. 3a); ventral lobe of cercus with truncate marginal tooth (Fig. 4a); cercus in dorsal view as long as to slightly longer than S10; S9 black on posterior half ..... *A. axine*

1'. Cercus in lateral view lobate with distal margin concave to slightly concave, tip of paraproct well proximal to ventral lobe (Figs 1b, 3b, c); ventral lobe of cercus without marginal tooth (Figs 4b-d); cercus in dorsal view distinctly longer than S10; S9 entirely blue 2

2. Apical width of cercus in lateral view nearly equal to cercus length (Fig. 3b); ventral lobe of cercus with a medial black tooth, centrally-located (Fig. 4b); genital ligula with a short, lobate process on inner margin of apical segment (Fig. 5a); TL 32.0-37.5 mm ..... *A. dorsale*

2'. Apical width of cercus in lateral view about 2/3 cercus length (Figs 1b, 3c); ventral lobe of cercus without a medial black tooth (Figs 4c, d); genital ligula with a long, slender curved process on inner margin of apical segment (Figs 1d, 5b); TL 27.4-33.0 mm 3

3. Cercus in lateral view wider at base than at apex (Fig. 3c); rear of head mostly black above occipital foramen; scythe-like subapical process of genital ligula long (0.23-0.24 mm) and strongly curved (Fig. 5b); HwL 15.5-18.0 mm ..... *A. inca*

3'. Cercus in lateral view wider at apex than at base (Fig. 1b); rear of head usually mostly pale above occipital foramen; scythe-like subapical process of genital ligula short (0.13-0.15 mm) and moderately curved (Fig. 1d); HwL 14.3-16.0 mm ..... *A. philipi*

Key to females of *Aeolagrion*

1. Mesanapleural suture barely curved and mesepisternum without a ridge or depression posterior to mesostigmal lamina (Fig. 2b) ..... *A. axine*

1'. Mesanapleural suture usually with marked convexity and mesepisternum with a low ridge, depression or tubercle posterior to mesostigmal lamina (Figs 1g, 6a, b) 2

2. Mesepisternum with a depression between a pale ridge immediately posterior to mesostigmal lamina and a more posterior pale tubercle (Fig. 6a); labrum darker than clypeus ..... *A. dorsale*

2'. Mesepisternum without a depression posterior to mesostigmal lamina (Figs 1g, 6b); labrum usually about same shade of pale blue as clypeus 3

3. S8 blue; rear of head black above occipital foramen; cercus length by width ratio 1.25-1.60; stylus of ovipositor 0.30-0.35 mm long ..... *A. inca*

3'. S8 brown to black; rear of head pale brown or tan above occipital foramen; cercus length by width ratio 1.80-2.50; stylus of ovipositor 0.20-0.25 mm long ..... *A. philipi*

Distribution of *Aeolagrion*

General distribution of *Aeolagrion* species, based mainly on specimens I examined, supplemented with reliable literature and personal collection records (designated by asterisk) is: *A. axine*: Ecuador; *A. dorsale*: Bolivia, Brazil, Ecuador, Peru, Surinam, Trinidad, *Venezuela (Dunkle 1991), *Surinam (Williamson 1917); *A. inca*: Bolivia, Peru, *Ecuador (Dunkle 1991; D.R. Paulson pers. comm.), *Brazil (Sjöstedt 1918 as *foliaceum*; Lencioni 2006); *A. philipi*: Bolivia; *N Argentina (R.W. Garrison, pers. comm.).

Discussion

The ventral lobe of the cercus is the most useful diagnostic character for determining male *Aeolagrion* to species. Based on the morphology of the genital ligula and cerci, it appears that *A. axine* and *A. dorsale* are more closely related to each other than to *A. inca* and *A. philipi*. The hind lobe of the prothorax in males is somewhat variable, but in lateral view, the medial portion usually extends dorso-apically higher above the middle lobe in *A. dorsale* (Fig. 7a) than in *A. inca* and *A. philipi* (Figs 7b, c). Females are difficult to separate; the key characters should allow identification of most specimens. *A. philipi* females have the most slender cerci, the length/width ratio in lateral view varying from 1.8-2.5 (vs 1.25-1.6 in the other three species).

The extent of dark coloration in some features of *Aeolagrion* appears to be phenotypic and not due to ontogenesis. In both immature and mature individuals of *A. dorsale* and *A. philipi*, the posthumeral stripe may be a fully developed black or brown stripe, or nearly wanting; this stripe was black in all males of *A. axine* (27, B. Mauffray pers. comm.) and *A. inca* (35, D.R. Paulson pers. comm.) examined. The labrum in *A. dorsale* varies from pale brown to black. Selys (1876: 271) stated that the labrum was "bleuâtre-clair" (light bluish); this apparently was in error, as von Ellenrieder & Garrison (2007) examined the labrum of five males of *A. dorsale* in the IRSN and found it to be "pale, almost ochraceous" (yellow with a slight tinge of brown). The coloration in Selys' specimens might be unusual; the labrum in most *A. dorsale* males I examined was black. Intraspecific variation in posthumeral stripe and labrum color renders these characters useless in distinguishing species.

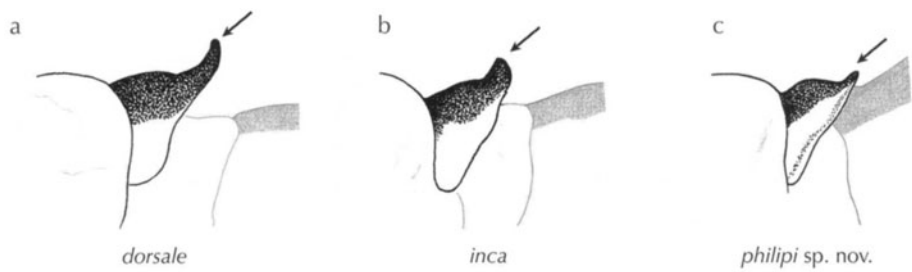

Figure 7: Male hind lobe of prothorax of three *Aeolagrion* species, lateral view — (a) *A. dorsale*; (b) *A. inca*; (c) *A. philipi*.

Aeolagrion damselflies are fairly cryptic shade-dwellers, especially females. Although the larvae and therefore the exact breeding habitat are not known for any of the four species, most adults I have seen, including mated pairs, were perched in shade of woody vegetation near overflow pools along larger streams. *Aeolagrion* damselflies become pruinescent on the sides and venter of the thorax, S1 and S8-9. The prevalence of pruinescence in shade-dwelling Neotropical damselflies has not been estimated. The major functions postulated for development of pruinescence are (Corbet 1999: 282): (1) to serve in territorial and sexual displays, and (2) to aid in thermoregulation by reflecting radiation and thereby avoid over-heating. Pruinescence in shade-dwelling damselflies might function also as a defense mechanism, making the insect more difficult to be seen, though in *Aeolagrion* it appears to be developed later in life. Some species of tropical forest damselflies live in a sexually immature state for months, having to avoid predators throughout the dry season. In species where pruinescence serves to help avoid detection by predators, it would be adaptive to develop it earlier in life. Therefore, it seems more likely that pruinescence, at least in *Aeolagrion*, signals sexual maturation, but perhaps also helps prevent desiccation. More research on pruinescence in Zygoptera throughout the adult maturation period is needed.

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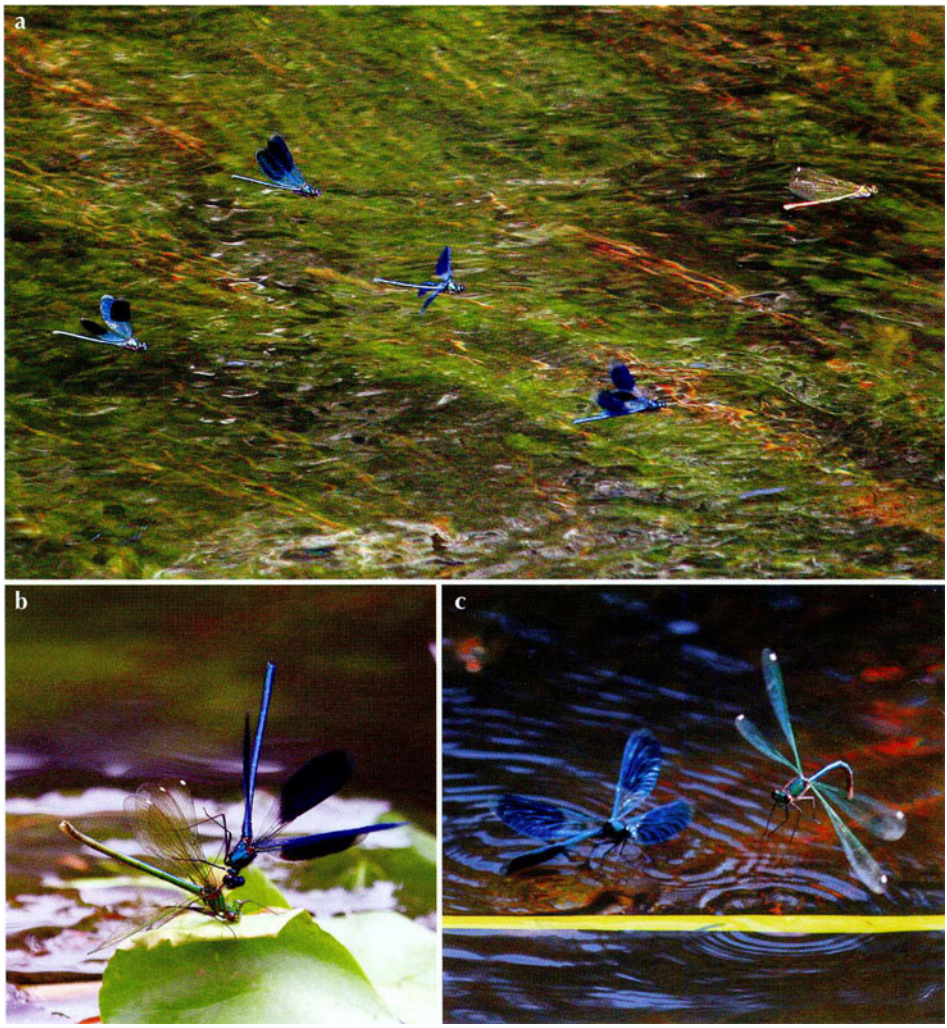
Colour plate I: *Libellago semiopaca* — (a) male; (b) female; Gunung Mulu National Park, Sarawak, 4 June 2004. Photos by Graham Reels.

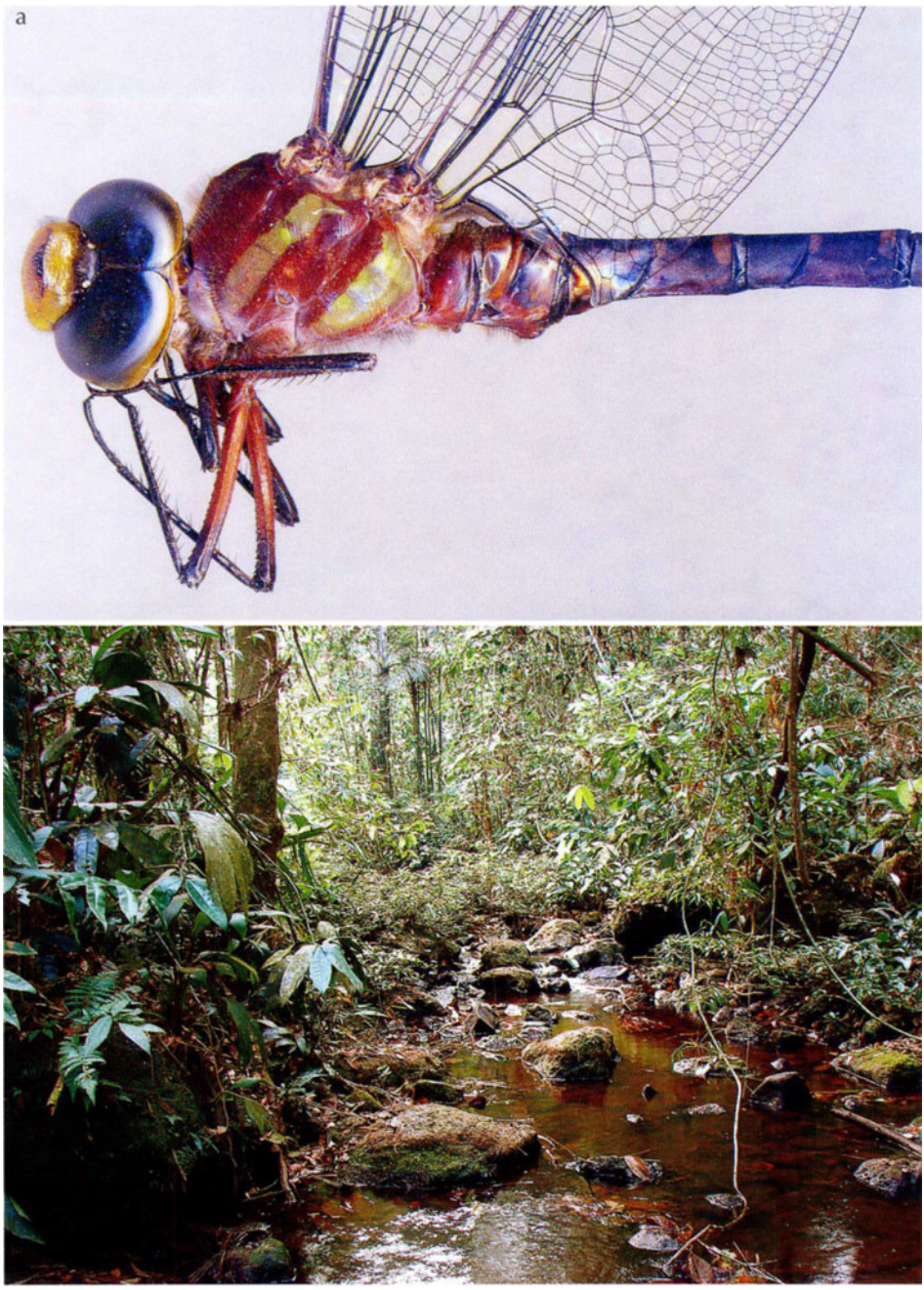
Colour plate II: Agonistic flight in *Libellago semiopaca*, Gunung Mulu National Park, Sarawak, 4 June 2004 — (a, b) stationary wing display by male on left; (c) stable contest, males circling one another. Photos by Graham Reels.

Colour plate III: Male and copula of *Somatochlora flavomaculata* — (a) hovering in its terrestrial territory – the plane of the hind wing is twisted off perpendicular to the body axis in its standstill phase while the fore wings beat rapidly; (b) pair formation was initiated midair in the terrestrial territory of the male, immediately followed by adoption of the wheel position. The pair then circled for minutes over dry vegetation and possible oviposition sites until it perched on a thistle stem away from water. The male was parasitized by a biting midge (*Forcipomyia paludis*) clinging to the base of the right hind wing. Photos by Beat Schneider (a) and HW (b).

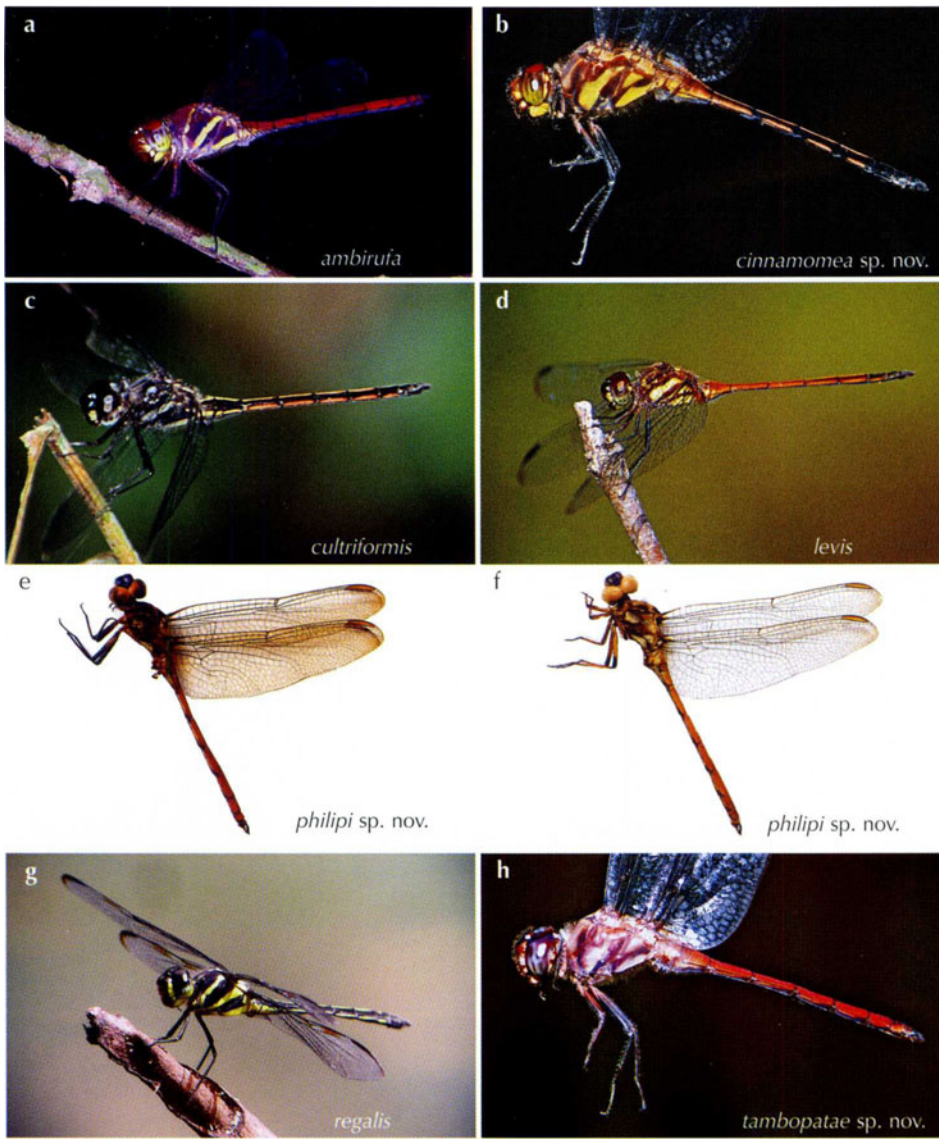


Colour plate IV: Reproductive behaviour of *Calopteryx splendens* on the Oker River, northern Germany — (a) males pursuing females, July 2007; (b) only when landing the female could be caught, August 2006; (c) defense posture of the female, July 2008. Photos by DH-R (b) and GR (a, c)

Colour plate V: *Libellago corbeti* sp. nov. near Kudawe, Ratnapura district, Sabaragamuwa Province, Sri Lanka, 3 July 2007 (♂) and 17 April 2008 (♀) — (a) male holotype habitus, lateral view; (b) male holotype head and rhinarium, dorsal view; (c) female paratype habitus, lateral view. Scale lines (a, c): 5 mm. Photos by George van der Poorten.



Colour plate VI: *Castoraeschna corbeti* sp. nov. — (a) scanned image of ♂ holotype, showing head and thorax, lateral view; (b) type locality at "Buritizal I", stream in Amazonian federal unit of conservation Floresta Nacional de Carajás, Parauapebas municipality, Pará state, Brazil, 28 September 2008. Photo by NFJr.



Colour plate VII: Neotropical *Orthemis* species of the *levis*-group, males — (a) *O. ambirufa*, tentative identification based on picture as there is no voucher specimen available, Brazil, Mato Grosso State, Cristalino Jungle Lodge, 5 October 2007;— (b) *O. cinnamomea* sp. nov., holotype, Peru, Madre de Dios Department, Explorer's Inn on Río Tambopata, main trail, 23 July 2002; — (c) *O. cultriformis*, Peru, Madre de Dios Department, Cococha swamp at Explorer's Inn, 29 July 2002; — (d) *O. levis*, Venezuela, Cojedes State, Hato Piñero, 31 December 2000; — (e) *O. philipi* sp. nov., holotype, Argentina, Salta Province, pond at route 15 between route 5 and Las Varas, 23 May 2008; — (f) *O. philipi* sp. nov., paratype, Argentina, Salta Province, pond at route 15 between route 5 and Las Varas, 23 May 2008; left pair of wings clipped; — (g) *O. regalis*, Brazil, Mato Grosso State, Cristalino Jungle Lodge, 25 October 2006; — (h) *O. tambopatae* sp. nov., paratype, Peru, Madre de Dios Department, Tambopata Research Center, forest pond, 20 July 2002. Photos by Johan van't Bosch (a); Dennis Paulson (b-d, h); NvE (e, f); Rich Hoyer (g).

Colour plate VIII: *Ischnura hastata* — (a) female, lateral view; (b) female, descending along a plant stem until being completely submerged, after having laid eggs in the surface vegetation; (c) larva, lateral view; (d) larva, dorsal view. São Miguel Island, July 2008 (a, c, d), Pico island, July 2003 (b). Photos by ACR.